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Energy indicators for sustainable development in Baltic States

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Abstract

This article summarises some of the results from the application of the Energy Indicators for Sustainable Development (EISD) tool for analysing trends, setting energy policy goals and monitoring progress towards these goals for Baltic States. This experience illustrates the potential applicability of the EISD methodology for energy policy development in economies in transition, using Baltic States as an example. The paper presents a summary of the analysis of six priority areas defined by EU accession requirements for new Member States and provides recommendations for sustainable energy policy development in Baltic States using this indicator approach.

Keywords: Energy indicators for sustainable development; Sustainable energy development; Energy strategy and policy

Contents

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1. Introduction

Much of the current energy supply and use, based as it is on limited resources of fossil fuels, is deemed to be environmentally unsustainable. Achieving sustainable development on global scale will require the judicious use of resources, technology, appropriate economic incentives and strategic planning at the local and national levels. It will also require regular monitoring of impacts of selected policies and strategies to see if they are furthering sustainable development or if they should be adjusted. It is important to be able to measure a country's state of development and to monitor its progress or lack of progress towards sustainability. First of all, it is necessary to know the country's current status concerning energy and economic sustainability, what needs to be improved and how these improvements can be achieved. Second, it is very important to for policy makers to understand the implications of selected energy, environmental and economic programmes, policies and plans and their impacts on the shaping of development and on the feasibility of making this development sustainable. Therefore, choosing energy fuels and associated technologies for the production, delivery and use of energy services, it is essential to take into account economic, social and environmental consequences. Policy makers need simple methods for measuring and assessing the current and future effects of energy use on human health, society, air, soil and water. For this purpose, energy indicators for sustainable development (EISD) developed by IAEA, UNDECA, IEA, EEA and EUROSTAT can be used [1].

The EISD is an analytical tool developed which can help energy decision- and policymakers at all levels to incorporate the concept of sustainable development into energy policy. The aim of this article is to show how the EISD approach can be used in analysing trends in the development of Baltic States energy sector in terms of sustainability, setting goals for sustainable energy development according to national and EU priorities, assessing progress made towards sustainable development and identifying new policy actions necessary to achieve these goals.

The EISD set is used to present energy, economic, environmental and social data for policymakers in a coherent and consistent form, showing their linkages and their usefulness for making comparisons, trend analyses and policy assessments [2]. These indicators permit interested parties to gauge their own progress in terms of sustainable energy development and to chart their own social and political course for reaching higher levels of achievements regarding energy, the economy and the environment.

The EISD set was applied for the analysis of the Baltic States energy sectors with a view to European Union (EU) energy policy requirements. Priorities of sustainable energy development in Baltic States are quite similar and there are mainly based on EU accession

requirements for energy sector. Some specific indicators were selected based on the peculiarities of energy sectors. Indicators relevant to Baltic States energy sector priorities selected from the EISD list were compared with the average values for the EU-15.

2. EISD core indicators

ISED core set is organized following the conceptual framework used by United Nations Commission on sustainable development (CSD). There are 30 indicators, classified into three dimensions: social, economic and environmental. These are further classified into seven themes and 19 sub-themes. Some indicators can be classified in more than one dimension, theme or sub-theme, given the numerous interlinkages among these categories. Also, each indicator might represent a group of related indicators needed to assess particular issues. There are four social dimension indicators, three of them represent equity (accessibility, affordability, disparities) and one—health theme (safety). Because of the difficulties to collect data on social indicators these were not included in our policy analysis conducted for Baltic States.

The set of energy indicators of economic dimension consists of 16 indicators. Fourteen of these indicators represent use and production theme and are divided according subthemes into: overall use, overall productivity, supply efficiency, production, end use, and diversification and price sub-themes. Two indicators (net energy import dependency, fuel stocks) define the security theme. In our analysis, almost all economic dimension

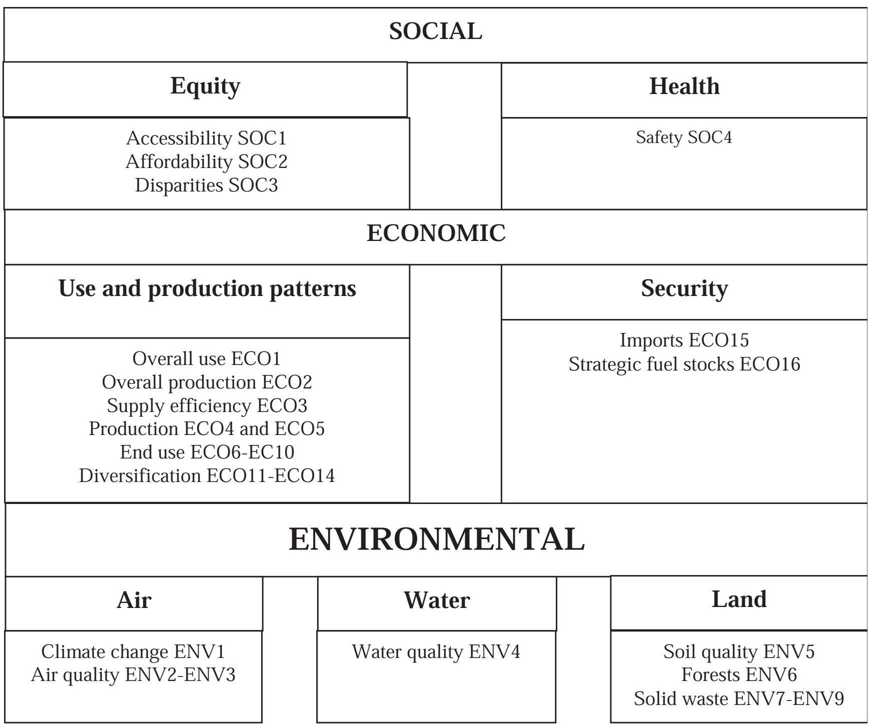

Fig. 1. Set of core EISD.

indicators will be used because they represent very clearly the priorities of EU and Baltic States energy policy.

There are nine environmental dimension indicators in the EISD core list. They are divided according atmosphere, water and land themes. For atmosphere theme two subthemes (climate change and air quality) were defined. Air quality sub-theme includes ambient concentrations of pollutants in atmosphere which is state indicator and air pollutants emissions into atmosphere from energy sector (direct driving force indicator).

The scheme of core EISD indicators is presented in Fig. 1.

3. Review of Baltic States energy policies

Baltic States have very limited domestic energy resources. The main source of electricity production in Lithuania is the Ignalina nuclear power plant. Over the past 5 years, it has generated 80–85% of the total electricity produced. The anticipated closure of this nuclear power plant in 2009 will significantly decrease the diversity of Lithuania's fuel supply and reduce overcapacity.

The main strategic goal of Baltic States energy policy was to prepare the energy sector for integration into the EU energy markets and to harmonize their energy policy with EU. The main targets of EU energy policy are to increase security and reliability of energy supply, opening of energy markets, promotion of renewables and cogeneration, reduction of impact on environment, climate change mitigation and increase of energy use efficiency. All these policies have positive impact on energy intensity decrease and reduction of GHG emissions. Baltic States have implemented all EU directives and this had a positive impact on energy intensity decrease as economies of these countries are constantly growing.

The main environmental requirements for energy sector are implemented by EU daughter directives. These directives can be grouped into three categories: directives promoting energy efficiency and use of renewable energy sources, directives implementing economic tools of environmental regulation and directives targeting reduction of pollutants emissions into atmosphere. The most important directives having the highest positive impact on security of supply and GHG emission reduction are those promoting use of renewable energy sources.

Baltic States based on requirements of directive 2001/77/EC have established the targets to be achieved in 2010 for electricity produced from renewables. Estonia and Lithuania have also established the targets for the share of renewables in primary energy supply to be achieved also in 2010 based on the provisions of EU White paper. Baltic States have implemented 2003/30/EC Directive on the promotion of the use of biofuels in transport setting that Member States must ensure by end of 2005 a 2% minimum proportion of biofuels of all gasoline and diesel fuels sold on their market. In longer term the target is to achieve a share of 5.75% of biofuels for transport in the total amount of fuels by 2010 and 20% by 2020.

There are a few main EU directives targeting reduction of pollutants emissions into atmosphere relevant to energy sector: LPC directive, sulphur directive and directive on emission ceilings, integrated pollution prevention directive and directive on the control of volatile organic compound (VOC) emissions resulting from the storage of petrol and its distribution from terminals to service stations. Implementation of directives relating to the reduction of pollutants emitted into the atmosphere will have positive impact on SO_2, NO_x and dust emission reduction in Baltic States [3].

Table 1
EISD selected for the energy policy analysis

Indicators	Acronym	Theme	Sub-theme	Type
Economic dimension				
Energy use per capita	ECO1	Use and production	Overall use	State
Energy intensity of GDP	ECO2		Overall productivity	Direct driving force
Energy supply efficiency	ECO3		Supply efficiency	Indirect driving force
Energy intensity of industry	ECO6		End use	Indirect driving force
Energy intensity in agriculture	ECO7			Indirect driving force
Energy intensity in commerce	ECO8			Indirect driving force
Energy intensity in household	ECO9			Indirect driving force
Energy intensity in transport	ECO10			Indirect driving force
Energy mix	ECO11		Diversification	Indirect driving force
Renewable energy share	ECO13			Indirect driving force
Net energy import dependency	ECO15	Security	Imports	State
Environmental dimension				
CO_2 emissions from energy sector per capita and unit of GDP	ENV1	Atmosphere	Climate change	State

There is a separate group of EU directives implementing economic tools of environmental regulation and having the significant impact on energy sector development in Baltic Sates. The implementation of EU directives 2003/87/EC—Directive on establishing a scheme for GHG emission allowance trading within the Community foresees that Member states shall start CO_2 emission trading among combusting installations with a rated thermal input exceeding 20 MW, mineral oil refineries, coke ovens, ferrous metals processing installations, mineral industry, pulp and paper producing installations by issuing certain amount of tradable emission permits free for 2005–2007 period according the National allocation plans to be adopted by Commission. 2003/96/EC Directive restructuring the community framework for the taxation of energy products and electricity aims to impose taxation of energy products and electricity since January 1 2004 based on minimum.

The appropriate EISD were selected to address the priority concerns and strategic priorities of Baltic States energy sector development with defined primary targets and relevant response actions. The selected EISD are listed in Table 1.

The response actions based on the targeted indicators define the possible policy measures and actions to be implemented in order to achieve progress towards primary targets.

The priority areas for energy sector analysis in Baltic States were selected based on the main EU energy policy directions [4]. These priority areas are as follows:

- Energy use.
- Energy intensities.

- End-use intensities of economic branches.
- Energy security.
- Environmental energy impacts.

Trends in energy use, energy intensities, and structural changes of the economy and energy security were analysed using economic dimension indicators. Environmental impacts from the energy system were described by environmental dimension indicators. This article discusses only emissions of carbon dioxide (CO_2) because climate change mitigation policy is a priority environmental policy in EU and Baltic States. CO_2 emission trends can be related to implemented energy policies, and the analysis can be useful in the formulation of effective new policies.

4. Analysis of priority areas of energy sector development for Baltic States

4.1. Energy consumption per capita

Energy use is analysed based on overall and per capita energy use. Fig. 2 shows total primary energy supply (TPES) per capita in Baltic States and EU-15 [5–8].

Energy use per capita is ECO1 indicator from EISD core list. A clear divergence exists between Baltic States energy consumption per capita and the corresponding averages for the EU-15. The per capita energy use indicates that, in 1990, Lithuania had higher energy use (4.46 tonnes oil equivalent [toe]/capita) than the EU-15 (3.61 toe/capita); however, after 1991–1992, energy use in Lithuania declined and remained below the corresponding average for the EU-15 up to 2000.

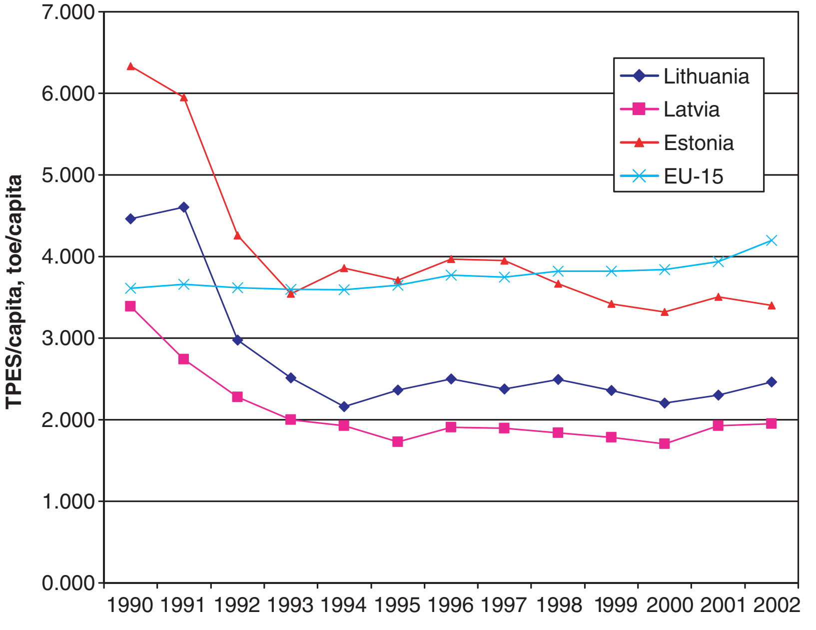

Fig. 2. Per capita TPES in Baltic States and EU-15.

From the analysis of energy use, the following conclusions can be drawn.

As one can see from Fig. 1 total primary energy consumption is the lowest in Latvia and the highest in Estonia. Though TPES consumption per capita is EU-15 was on the same level as in Estonia in 1993 this indicator was constantly decreasing in Baltic Sates since 1991 and in EU-15 it was slowly increasing. In Lithuania TPES/capita has decreased by 48% since 1991 and in Latvia and Estonia by 44% in the same period. In EU-15, this ration increased by 9% in the same time frame. In 2002, this ratio in EU-15 was by two times higher than in Latvia and by about two times higher than in Lithuania. In Estonia TPES/capita is the closest to EU-15 level. Since 2001 such trends in energy consumption decrease have changed in Latvia and Lithuania and TPES/capita started to increase [9].

4.2. Energy intensity

The overall energy productivity (total primary energy supply, final energy consumption and electricity per GDP) indicator ECO2 was selected as the targeted indicator for decreasing energy intensity in the economies of Baltic States. There is no doubt about the desirable future trend of this indicator, which is considered a direct driving force in the EISD framework. This indicator shows the general relationship of energy use to economic development, which is very relevant for assessing progress towards sustainable energy development.

Fig. 2 shows energy intensity for TPES per unit of GDP in Baltic States and in the EU-15. TPES/GDP has fallen sharply in Baltic States since 1992. In Lithuania and Estonia TPES/GDP has decreased about 37 and 44%, respectively and in Latvia about 30%. In the beginning of 90s, this was caused by deep economic recession than energy consumption decreased more than GDP decrease. After 1996, the decline in TPES per unit of GDP has been driven by energy intensity decrease, structural changes in economy. The changes in fuel mix and efficiency of energy supply did not have significant impact on energy intensity

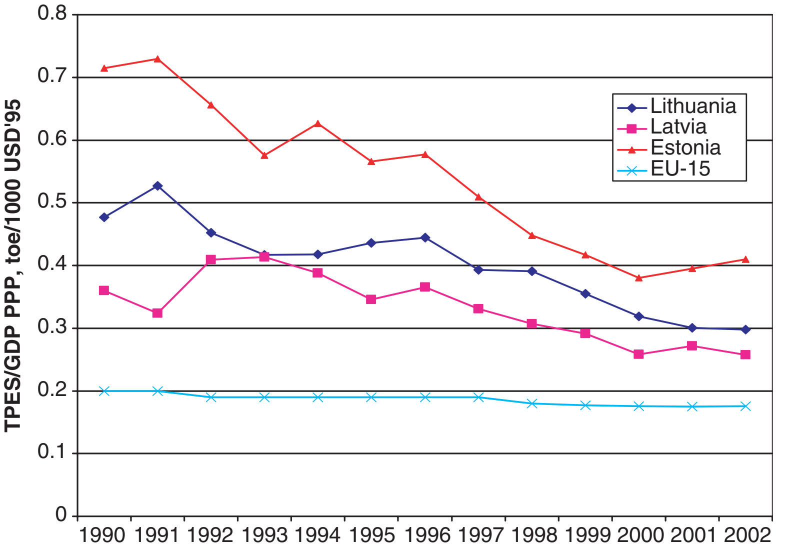

Fig. 3. Energy intensity TPES per unit of GDP in Baltic States and EU-15.

decrease (Fig. 3) because this ratio was almost constant during this period. During this time in EU-15 TPES/GDP has decreased only by 12%. And final energy intensity of GDP declined by 7.8%. Comparing current FEC/GDP levels in EU-15 and Baltic States one can notice that in Baltic States FEC/GDP is more than twice higher. TPES/GDP in EU-15 is twice lower than in Estonia and about 25–40% lower than in Lithuania and Latvia, respectively. Such big differences between final and primary energy intensity of Lithuanian economy can be explained by low FEC/TPES ratio [10].

The differences in energy consumption levels per unit of economic output reflects the differences in energy efficiency, however, it would be misleading to rank energy efficiency performance according to a country's energy per GDP measure as that ratio is affected by many non-energy factors such as climate, geography, travel distance, home size and manufacturing structure. Baltic States have similar climate, size of country and similar economic data consequently similar income, home size, car fleet but different economic and manufacturing structure.

4.3. End-use intensities of economic sectors

By analysing energy intensity at less aggregated levels, trends were further investigated for different sectors of the economy using the set of indicators on end-use intensities ECO6-ECO10 (ECO6, industrial energy intensities; ECO7, agricultural energy intensities; ECO8, commercial energy intensities; ECO9, households and ECO10, transport energy intensities) as the targeted indicator. The increase in the shares of the economic sectors that have higher value added but consume less energy is a favourable trend for reducing the energy intensity of GDP. The contribution of sectors to overall GDP value added is considered an indirect driving force indicator of the economic dimension.

The main conclusions from final energy intensity analysis are the following:

1. Analysis of final energy intensities development trends in Baltic States indicated quite different final energy intensity levels characteristic for Baltic States. Latvia distinguishes with highest final energy intensity in manufacturing sector. The rather high final energy intensity in manufacturing sector in Latvia forms from the structure of manufacturing branches, which could be characterized with comparatively high energy intensity. In all states final energy intensity was decreasing in industry the smallest decrease can be noticed in Latvia and the highest in Lithuania.
2. The final energy intensity in commercial sector is similar in all Baltic States but the trends of its development were different in the Baltic States since 1993. In Estonia final energy intensity in commercial sector has increased by 57% but in other states it has halved during the same period. In Latvia energy intensity of commercial sector in 1993 comparing with Estonia was three times higher, therefore, the increase of energy intensity of this sector in Estonia shows the trends in convergence of final energy intensity indicators among Baltic States.
3. Currently final energy intensities in transport are similar in Latvia and Lithuania but in Estonia this indicator is by 1.5 times lower. Final energy intensity in transport has increased in Latvia but has decreased in Lithuania and Estonia. Since 2000 final energy intensity is increasing in Estonia and Latvia. In 1993, final energy intensity was the highest in Lithuania (about two times higher than in Latvia and 1.2 times higher than in Estonia). The trends of final energy intensity convergence can be noticed in Baltic States.

Final energy intensity in agriculture was the highest in Latvia [11]. In all Baltic States, final energy intensity in agriculture has decreased during 1993–2002.

4.4. Energy security

Net energy import dependence (ECO15) was selected as the targeted indicator to analyse the security of energy supply. This targeted indicator is a state indicator and is affected by the following indirect driving force indicators within the energy sector: energy mix or the structure of energy supply in terms of shares of energy fuels in primary energy supply and electricity generation (ECO11), renewable energy share in primary energy supply and electricity (ECO13) and energy supply efficiency (ECO3).

Energy security is a major issue in Baltic States because net energy import dependence in these countries is high and it is expected that in 2009, when the Ignalina nuclear power plant is closed, it will increase significantly in Lithuania (up to 90%). Fig. 4 presents energy import dependency in Baltic States and EU-15 [12].

As the Baltic States energy sectors depends on energy imports, major efforts are necessary to increase indigenous energy production and utilisation of renewable energy sources even though per energy unit costs may be higher. In 2000, renewable energy sources amounted to 9.2% of the total primary energy mix in Lithuania (in Estonia and in Latvia). The EU-15 target is 12% renewable energy sources in the overall energy balance by 2010. The same target is set for Lithuania in the third National Energy Strategy [13], adopted in 2002. The share of renewable electricity in total electricity production is very small in Lithuania at only about 3 (in Latvia 29% and Estonia about 1%), compared with over 14% in the EU-15 (see Fig. 5). The EU-15 target for 2010 is 22.1%. Lithuania has agreed with the European Commission to reach 7% by 2010. The same target is included in

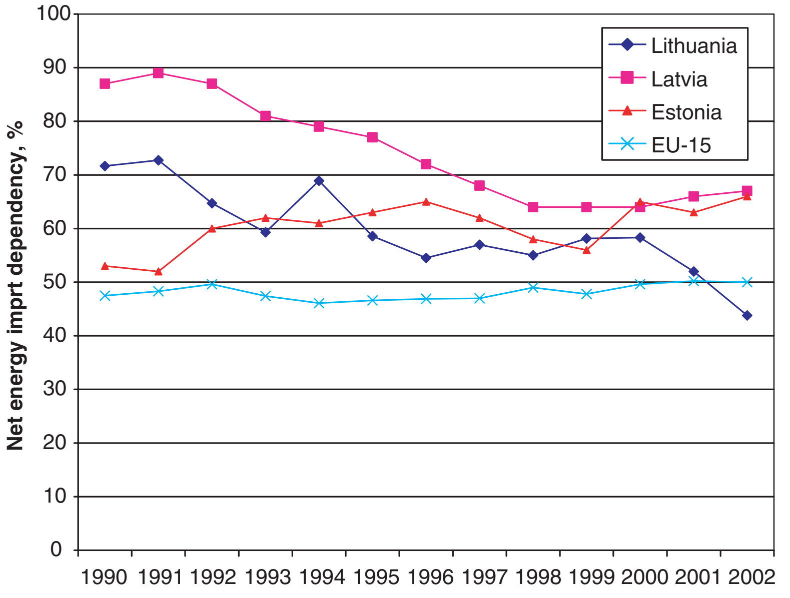

Fig. 4. Net energy import dependency in Baltic States and EU-15.

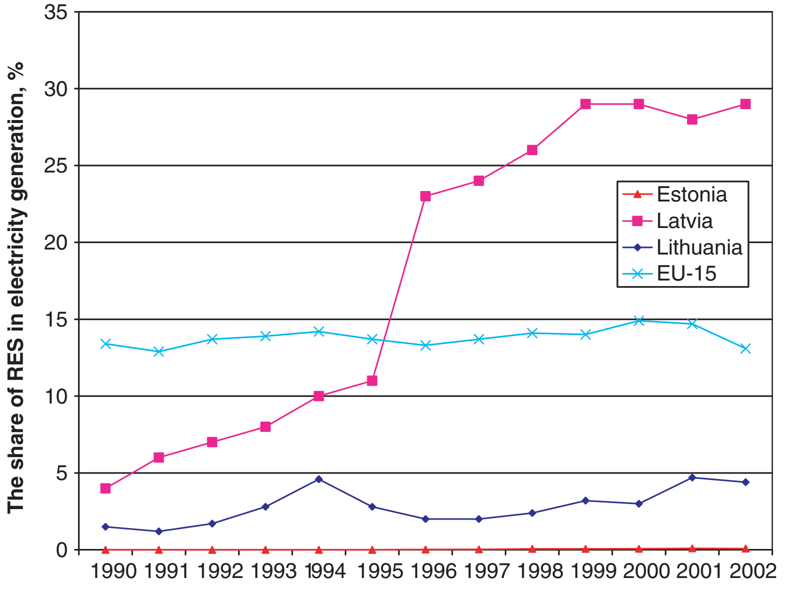

Fig. 5. Contribution of renewables to total electricity generation in Baltic States and EU-15.

Lithuanian sustainable development strategy [14]. Measures to enhance utilisation of renewable energy sources are necessary.

Energy supply efficiency (the ratio of final to primary energy use) has a significant impact on net energy import dependence, because an increase in energy supply efficiency helps to reduce energy import dependence.

The decline in FEC/TPES can be noticed in Lithuania and Latvia. In 2002, this ratio was by 9% lower than in 1990 for Lithuania and about 4% lower for Latvia in the same period. In the case of Lithuania, the main reason of this is the increased share of electricity in final energy demand. Electricity has the high-energy use efficiency compared to direct fuel application, but often-significant losses in generation. Thus the increased share of electricity moved losses from demand side to supply side, which more than offset the improvements in supply efficiency achieved during the same period. In the case of Latvia the main affecting factor to the changes of this index is the share of hydro energy and imported electricity in the structure of power supply. This share varies in the very wide range from 76% in year 2002 up to 83.5% in year 1998. Hydro energy and imported electricity move from TPES to FEC with 100% efficiency. Consequently FEC per GDP fell more than TPES/GDP in Lithuania and Latvia. In Estonia, it was almost stable [15]. In EU-15, this ratio even increased but not significant.

Energy import dependency declined in Lithuania and Latvia during the 1990–2000 period, dropping from 56% in 1990 to 43% in 2002 in Lithuania and from 87 to 67% in Latvia and increasing from 53 to 66% in Estonia (Fig. 6). In comparison, the energy import dependency in the EU-15 in 2002 was about 50% in the same year [12]. Policy measures aimed at increasing energy supply efficiency—that is, reducing losses in gas and oil transportation and electricity transmission and distribution, and increasing the efficiency of electricity generation, etc.—are necessary.

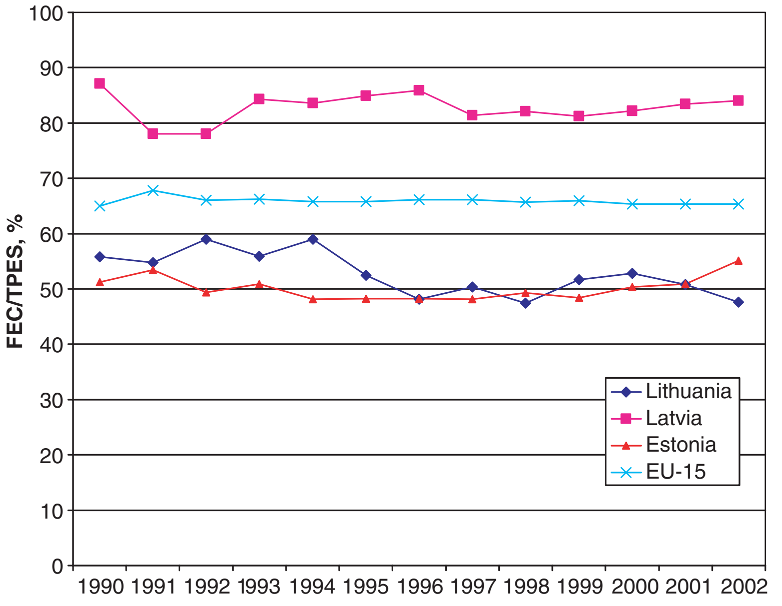

Fig. 6. FEC/TPES in Baltic States and EU-15.

4.5. *Environmental impact*

One of the main environmental impacts from the power sector that can be expected in Lithuania in the near future relates to climate change. The environmental impact of increased greenhouse gas (GHG) emissions is directly related to the impending final closure of Ignalina, Lithuania's only nuclear power plant. ENV1 (quantities of CO_2 emissions from the energy sector) was selected to analyse the environmental impacts.

Currently, CO_2 emissions per kilowatt-hour (kWh) in the EU-15 are twice those in Lithuania, and electricity consumption per capita is also more than twice as high. Although GHG emissions do not currently seem to be a serious problem for Lithuania, with the closure of the Ignalina nuclear power plant in 2009 these emissions will increase significantly. GHG mitigation policies should be implemented in Lithuania.

Emissions of CO_2 per kWh from the energy sector for the 1990–2000 period decreased in Baltic States and the EU-15 (see Fig. 6). In the EU-15, CO_2 emissions per kWh decreased while per capita electricity consumption increased during the period considered [16]. CO_2 per kWh in Estonia are more then tree time higher comparing with EU countries. This is related with the structure of fuels for electricity production. In Estonia about 99.8% of electricity is being produced by combustion of fossil fuels (including 93.5% of oil shale) and only 0.2% from renewable. Since 1994 CO_2 per kWh were increasing in Estonia only since 1990 some trends of CO_2 emissions per kWh decrease can be noticed. In Latvia and Lithuania, CO_2/kWh are more than three times lower than in Estonia and by two times lower than in EU-15. Especially this is related with very favourable electricity generation structure in Lithuania (more than 80% of electricity is being produced by nuclear). As one can see from Fig. 7 CO_2 per kWh in Lithuania is significantly lower comparing with EU-15. In 1994 CO_2 emissions per kWh amounted to 280 g/kWh and since 1995 it significantly

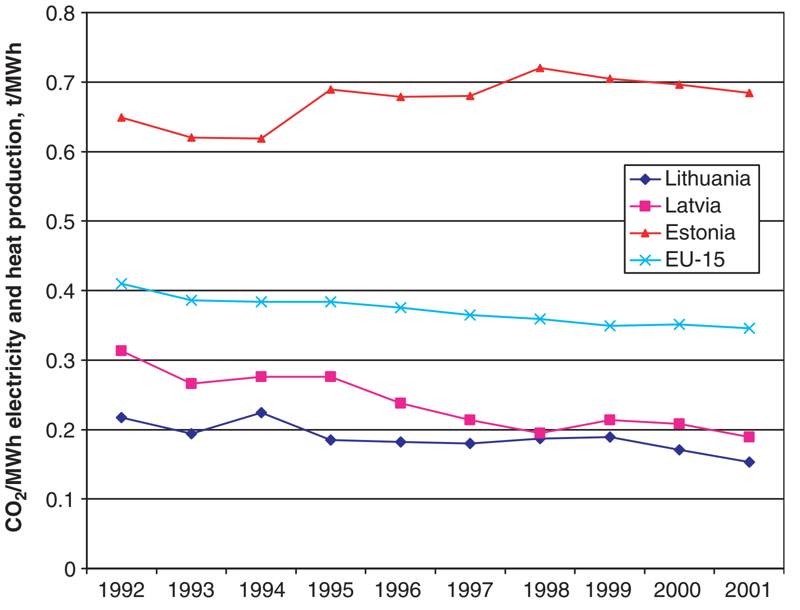

Fig. 7. CO_2 emissions per capita in Baltic States and EU-15.

decreased—up to 155 g/kWh. This is related with the changes of electricity generation structure by type of fuel in 1994. In 1994, fossil fuel amounted to 17% and nuclear to 79%. Starting since 1995 the share of nuclear in total electricity production makes about 75% and oil—about 10%.

Intensity of CO_2 emission reflects the contribution of the economy and society to the global warming. The intensity indicator is defined as the amount of CO_2 emitted in the country to generate a unit of GDP. The intensity of CO_2 emissions decreased during the 1990 to 2002 almost for 50%. In 1990, the level of CO_2 emission intensity was 3.12 but in 2002 only 1.57 tons of CO_2 per 1990 USD PPP. It means that reductions of CO_2 emissions are caused no longer by recession of economy, but now by better 'technological performance'.

The intensity of CO_2 emissions has decreased in Lithuania over the 1990s. The absolute level of CO_2 emissions intensity in Lithuania is about 0.5 kg/USD in 2001 and was very similar with EU-15 level in the same year 0.4 kg/USD.

CO_2 per capita is often cited as a key indicator of a countries' ability to pay for GHG reductions. All top 15 parties of UNFCC convention are developed economies. In Fig. 8, the development of CO_2 per capita in Baltic States and EU-15 is presented.

5. Recommended policies

5.1. Linkages between indicators

Fig. 9 shows the linkages among the indicators selected for energy policy analysis in Baltic States. Relevant policy actions based on analysis conducted in the previous sections are defined based on targeted indicators. The numbers in Fig. 9 refer to the identification numbers of the indicators of the EISD listed in Table 1.

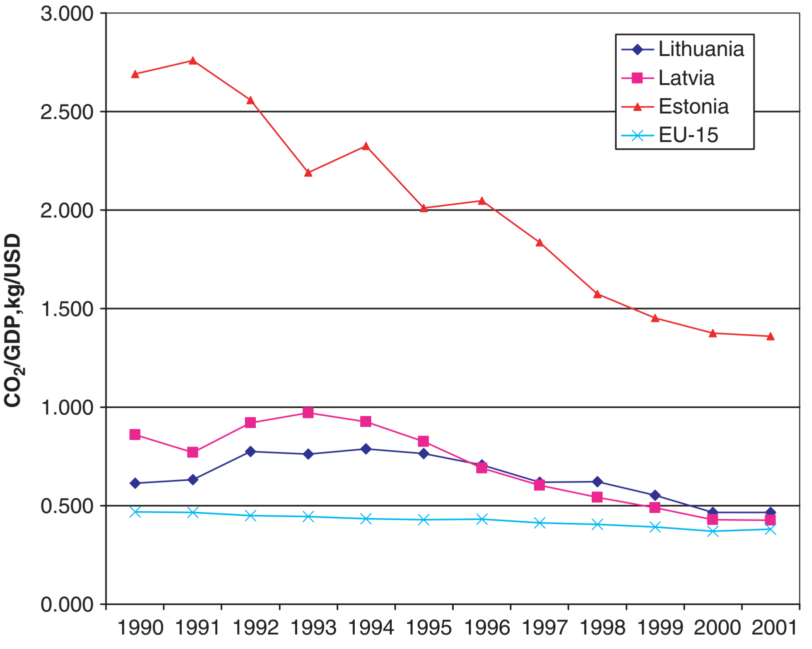

Fig. 8. CO_2/GDP in Baltic States and EU-15.

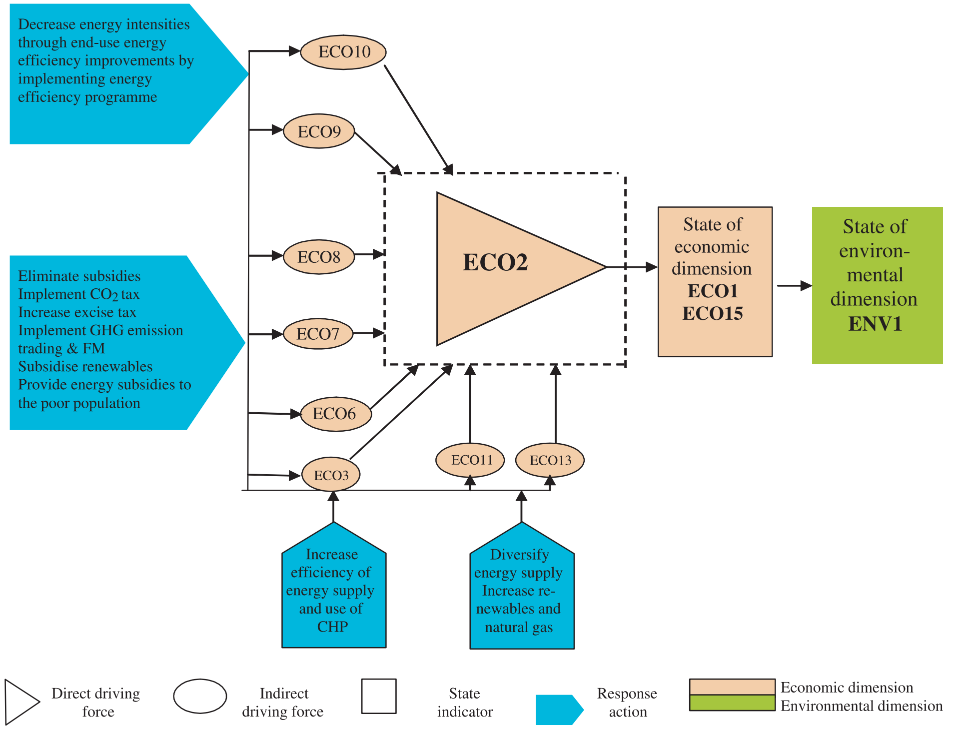

Fig. 9. Linkages between indicators and relevant policy actions based on the targeted indicators.

5.2. Policies to reduce energy efficiency

A major policy measure or response action to reduce energy intensity is to increase endues energy efficiency. Baltic States have adopted programmes on energy efficiency improvements, which are the effective tool to achieve this goal. These programms have been continuously revised. They encourage the integration of energy efficiency programmes in all sectoral policies. Implementation of legal and regulatory frameworks enabling an environment favouring energy efficiency is crucial in this sense. There are still many areas for improvement, such as household use, which reflects patterns (and wastefulness) induced by a long period of very cheap energy. Heating is a key problem. As household use is a large share of total final energy use in Baltic States, overall energy efficiency is still quite low and far below the levels in the EU-15. The transport sector is also an area for concern: the use of old and inefficient motor vehicles results in higher than necessary energy use and increased pollution.

In general, in Baltic States and other Central and East European (CEE) countries, the transport sector contributes less, and the household and industrial sectors contribute more, to energy use compared with the EU-15. This will change with the expected increase in the number of private automobiles and the growing freight transport activity between Eastern and Western Europe. Policies to increase energy use efficiency and reduce emissions in the transport sector are necessary.

As in other CEE countries, some energy support measures still exist in Baltic States (e.g. reduced value-added tax for district heating, exemptions from environmental standards, etc.). Removal of these subsidies would provide further incentives to increase energy efficiency and reduce energy use, although specific schemes should be in place to ensure affordability for the low-income sectors of the population. The introduction of a CO_2 tax and an increase in excise taxation (EU Directive 2003/96/EC on restructuring the Community framework for the taxation of energy products and electricity) are very important economic incentives to reduce energy intensity. Therefore, to achieve a decrease in energy intensity, the main policy actions are improvements in end-use energy efficiency (affected by energy pricing policy, as well) and the implementation of measures already foreseen in the programmes on energy efficiency improvements.

The structure of the economy affects the energy intensity of GDP. Further optimization of economic activity levels in Baltic States through reductions in the share of energy-intensive sectors and industries should be pursued. For Baltic States having limited natural resources, the structure of the economy should be the least energy intensive possible. The commercial/services sector and industries with low energy intensities (e.g. food and light industry, electronics and information technology) should be developed or expanded in the future.

5.3. Policies to increase security of supply

In the field of energy supply security, the main policy actions selected based on the targeted indicators for Baltic States are as follows:

- Enhance the diversity and variety of the energy mix.
- Improve maintenance of existing energy infrastructure.
- Eliminate constraints hampering modernisation and investment in new facilities.

- Increase the efficiency of energy supply in electricity generation.
- Increase the share of electricity produced by combined heat and power (CHP) plants.
- Increase the share of renewable and domestic energy sources in the energy mix.

The closure of Ignalina by 2009 poses the threat of power shortages in Lithuania and other Baltic States which have interconnected electricity supply systems. Therefore, for the security of supply and for integration into the EU electricity market, it is necessary to build a power bridge between Baltic States and Western Europe. The European Commission has already promised to support the 1000 MW power bridge between Lithuania and Poland, which will increase security of supply in the Baltic region. The underground cable connecting Estonia and Finland is under construction now.

The efficiency of energy supply needs to be increased in Baltic States, as the obsolete electricity grid and old infrastructure lead to high losses and low efficiency levels. The current privatisation of electricity transmission networks will enable the upgrading of grids and other equipment. Privatisation of electricity and heat generation plants will also help increase electricity generation efficiencies. The policy to increase share of CHP in electricity generation stipulated by EU would also have positive impact on increase of efficiency of energy supply. The feed-in prices for electricity purchase from CHP applied in Latvia can serve as a good example for CHP promotion in other Baltic States.

Policies to support the use of renewable energy sources should be continued in Baltic States. An important EU goal is to increase the share of renewable energy sources in the energy and electricity mix. For this purpose, additional support measures for renewable electricity are necessary. Baltic States have already implemented a direct price support scheme for electricity generated from renewable energy sources. Flexible market-based support measures include green certificates, which are not available in Lithuania but such voluntary system is available in Estonia. Such voluntary green certificate systems can be also introduced in Latvia and Lithuania based on Estonian experience. The EU emission trading scheme implemented on 1 January 2005 will also have a positive impact on the promotion of renewable energy sources in the electricity market.

It is widely recognised that prevailing pricing, fiscal and financing mechanisms in CEE countries do not support the efficient use of energy or the wider use of new and renewable energy sources. Internalisation of environmental externalities in energy prices would be an important approach to achieving these aims. However, an increase in energy prices should be accompanied by improved support schemes for the low-income population to ensure energy affordability.

5.4. *Environmental policies*

GHG mitigation options in the electricity and heat sector can be supply-side or consumer oriented. Supply-side GHG mitigation options in the energy sector include improvement of combustion efficiency, re-powering of electricity plants, fuel switching, reduction of transmission and distribution losses, and dispatch modification, among others. In more general terms, there are a number of ways to mitigate GHG emissions: increase efficiency and switch to a fuel with a lower carbon content, or expand the power system using new generating technologies. There are many options for new generating technologies, including advanced fossil fuel systems (combined cycle) and non-fossil fuel systems (hydro, renewables, nuclear).

GHG mitigation options on the consumer side are related to the introduction of CO_2 taxes and a GHG emission trading scheme. Integrating environmentally related economic instruments into economic decision-making is a new concept in Baltic States although pollution charges have been applied for years. Estonia has implemented CO_2 tax in 2002 and Latvia—since 2005. Lithuania is going to implement CO_2 tax, however, this tax as in Latvia will be applied in sectors not covered by the emission trading scheme. Estonian CO_2 tax is being applied for energy sector which is covered by emission trading scheme.

6. Conclusions

The EISD package allows the assessment of conditions and trends in relation to the goals and targets of sustainable energy development. The EISD package also facilitates comparability of trends in relation to goals and targets, and comparability of trends over time with respect to cause-effect relations and data from different countries. In addition, they allow the linking of policy actions with set goals and the assessment of progress achieved towards goals.

For the application of the EISD package in the development of Baltic States energy policies and the evaluation of effectiveness of already implemented policies which were driven by EU accession the following priority areas were selected:

- Energy use.
- Energy intensities.
- End-use energy intensities of economic sectors.
- Energy security.
- Environmental energy impacts.

A set of indicators from the EISD package was selected to address these priority areas.

In general, the analysis of targeted indicators shows some positive trends in relation to sustainable development in the Baltic States energy sector. Nevertheless, some issues require more attention. These issues are energy intensity, security of supply, including promotion of renewable energy sources and energy efficiency improvements. Energy affordability is also a matter of concern but was out of the scope of our analysis because of the data restrictions.

New policies should be implemented to address these problems. Policies and measures to enhance renewable energy sources and CHP penetration into the electricity market and to reduce energy transformation losses in the system should be implemented in Baltic States seeking to implement EU directives promoting use of RES and cogeneration. The experience should be shared among Baltic States in this field. These policies can be considered as policies to get energy prices right (e.g. removal of subsidies for conventional energy sources, introduction of feed-in prices for electricity purchased from CHP in Lithuania and Estonia, implementation of voluntary green certificates systems in Latvia and Lithuania, participation in the EU emission trading scheme and the introduction of a CO_2 tax in Lithuania).

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